Participatory Design of Computer-Supported Organizational Learning in health care: methods and experiences

Toomas Timpka MD PhD, Cecilia Sjöberg PhLic, Niklas Hallberg MSc, Henrik Eriksson PhD
MDA, Linköping University, S-581 85 Linköping, Sweden

Patrik Lindblom MSc, Per Hedblom MSc, Birgitta Svensson RN, Hans Marmolin PhD
UI Design AB, Ågatan 31, S-582 22 Linköping, Sweden

This paper outlines a Computer-Supported Co-operative Work (CSCW) system for primary care and presents from its participatory design process time consumption, costs, and experiences. The system integrates a hypermedia environment, a computerized patient record, and an electronicmessage system. It is developed to coordinate organizational learning in primary care from micro to macro levels by connecting strategic planning to monitoring of patient routines. Summing up design experiences, critical issues for making CSCW systems support cost-effectiveness of health care are discussed.

INTRODUCTION

Systems for medical quality assurance being exceptions[1], few clinical computer applications have been able to claim strategic value for health care organizations[2]. Successful 'business process'-oriented systems require adaption to non-procedural routines and management hierarchies[3]. For workplace integration, user-centered design methods have been developed, such as participatory design and joint application design[4]. However, even though preliminary evaluations have showed up to 60% cost reductions[5], strong evidence for the cost-benefit of user-centered design is still missing[6].

PRIMUS 2000 started 1993 as a 'model development' project for Swedish primary care. The project was distinguished by an emphasis on development of information technology to support efficiency and service quality, participatory design methods, and collaboration between health care providers, industry, and reseachers. This article presents process and outcome data from the design of a Computer Supported Co-operative Work (CSCW) system for organizational learning in which organizational communication and workflow monitoring are supported.

METHODS

Participtory action research (PAR) methods were used[7,8]. In the study project, the requirements specification for configuration of a CSCW system and the related redesign of clinical workflow was to be developed.

Project organization

The PRIMUS 2000 demonstrator site at Torkelbergsgatan Community Healthcare Center (TCHC), Linköping, Sweden, serves a population of 20.000 and employs 8 GPS and 52 staff. According to the principles of PAR, practitioners from TCHC participated actively with reseachers and software engineers as co-designers in the development process. Data about time consumption, costs, and experiences was collected from fieldnotes, meeting memos, transcripts from video recordings, project reports, and project diaries. The design group was composed of 22 persons; 11 primary care practitioners, 8 designers and 3 occasional domain experts. For the CSCW environment, three system types were available to be merged: hypermedia authoring and presentation, electronic messaging, and a computerized patient record (CPR). To introduce organizational learning concepts at the demonstrator site, a series of lectures presenting industrial quality management were arranged. The baseline for the design process was thereby set to be a respository of software methods and modules, supplemented with industrial quality management methods.

Software development methods

To provide a framework for organizational learning in a practice setting, the system components were to be a combination of adapted commercial products and

0195-4210/95/$5.00 © 1995 AMIA, Inc.

software developed within the project. The implementation was to be built on the OLE 2.0 standard and a client-server architecture. Available hardware included a HP 9000/800 E35 server supporting 43 AST Bravo PC workstations and 23 HP Laser/Desk Jet printers. Add-on equipment included CD-ROM units and audio facilities.

Communication software

For management of hypermedia documents, the Synkop Interactive Reference Book system was used. Being based on the MEDEA prototype[9], this system has been developed in the PRIMUS 2000 collaboration. It consists of three interactive environments: an authoring environment for development of hypermedia reference books; a system for distribution and management of hypermedia collections; and a set of tools for search retrieval from remote databases. The local information is stored in HTML format. The software for electronic messages was implemented using modules from the ICL Embla (TM) and MS Mail (TM) commercial email interfaces, and PC-TCP connections to the local Internet node.

Workflow monitoring software

DialogJournalen 2.1 was used as platform for the workflow monitoring software. This CPR for primary care supports a full-text medical record, a controlled medical terminology, a structured patient database and tools for report of patient data. The CPR was integrated with Göstas Book[10], a Synkop application consisting of a collection of hypermedia documents for primary health care, supplemented with annotation facilities. In April 1995, Gösta's Book held 11.400 text pages, 700 images and 60.000 active reference links.

Quality system methods

For redesign of the clinical workflow, both the social aspects of quality systems concerning the perspective on human resources and management of the development activities, and the technical aspects addressing the work procedures of the enterprise were recognized[11].

Customer orientation

Quality systems were introduced as being based on the *external-internal* customer relation. The external customer relates the provider to the market, while the internal customer determines effectiveness and efficiency. To disseminate this perspective in the organization, an initial emphasis was suggested on the existing management process[12]. Thereafter, for coordination of the improvement measures with business strategies, all work-flow procedures were to be scrutinized from external and internal perspectives: 'If the activity is not helping our customer, why are we doing it?', and 'To better support our colleagues, can the processes in the activity be improved?'.

Workprocess monitoring

The basis of the technical part of quality systems is the description of daily workflow and correction of the root causes to problems[13]. This monitoring was described to have a background in 'management based on information' and being performed in cycles such as the Plan-Do-Check-Act procedure[14]. For workflow descriptions, statistical procedures, flow charts, check sheets, and graphical analysis methods such as cause-and-effect diagrams were introduced[15].

RESULTS

The participatory design process

Twelve participatory design meetings were held having on average 11 participants (Table 1). Each design group member participated in, on average, 6 meetings.

Process experiences: The cost for the requirements specification process was USD 22.000 (154.000 SEK) or 9% of the total USD 235.000 (1.65 MSEK) system budget. Analyis of videotapes from meetings revealed two characteristics. First, 'spokespersons' expressing opinions came to be informally nominated in both the designer and staff groups. Second, from initally having a technical content, the later meetings came to mainly address clinical and organizational issues. The specification process resulted in formation of two types of continuous workshops for structuring of the organizational learning.

Table 1. Time consumtion displayed as person-hours in the participatory design of the PRIMUS 2000 CSCW system.

	Meeting time (h)	Preparation time (h)	Total time (h)
Designers	80	50	130
PHC staff	130	35	165
Experts	12	10	22
Total	222	95	317

Organizational communication workshops

The organizational learning at TCHC was designed to be based on the formulation of a service strategy at the unit level. In the strategy, health care segments and service responses to consider are decided and areas where working conditions need to be improved are pointed out. A *management strategy workshop*, involving 12 staff members and chaired by the head GP, was formed to reflect upon the management processes. The workshop has a yearly turn-over and scans changes in external requirements and markets. In parallel, a *working-life strategy workshop* with 15 members representing all professions evaluates the organization of the daily work at the CHC. Following negotiations between the both strategy workshops, directives are communicated for service process monitoring.

Redesign experiences: Even though the former being contained in the latter, confusion came to occur between the TCHC management and the management strategy workshop about managerial responsibilities. This was addressed by directing decisions to the management group, leaving management process issues to be discussed in the workshop.

CSCW methods

For the strategy development, the electronic message system is used for sharing of material from micro to macro organizational levels. At the internal workshop level, negotiations and sharing of material is supported. The collection of reports from work-flow monitoring workshops is supported by data analysis modules in the CPR and annotation facilities in the Synkop system. At the organizational unit level, distribution of the service strategy is supported by providing it as a hypermedia document. At the level of the external health care organization, the Synkop information retrieval tools use the Mosaic interface for access to text and images over Internet. Hereby national and regional libraries and public health databases are made available for strategic planning. Functions are also provided for integration of information generated from external systems into Synkop applications and for making personal annotations.

Design experiences: Formatted email and bulletin boards were found to be essential support functions for the organizational communication. However, it was also noted that most avaliable systems do not support structuring of email messages. Also, even though there was no intention to handle patient data, Internet connection was questionned by the health care administration due to security issues.

Process monitoring workshops

Monitoring of clinical and patient administration processes was organized into two permanent workshops. Following directions from the strategy workshops, specific areas are chosen for monitoring in Plan-Do-Check-Act cycles. Adjustments and smaller changes are immediately implemented and reports are regularly fed back to the strategy workshops. In the *workshop for monitoring of clinical processes,* consisting of 15 nurses and GPs, both medical and nursing procedures and outcomes are followed. In the *workshop for patient administration* with 12 members, a patient-centered description of the work-flow is kept and regularly updated. For the appointed services, directed surveys of patient satisfaction are performed and suggestions of change measures are reported.

Redesign experiences: Even though the interest among staff was considerable, the process monitoring was hard to coordinate. Therefore, needs were expressed for moe authorative control procedures from the management strategy workshops.

CSCW methods

The CSCW configuration supports the process monitoring, first, by allowing the service strategy for TCHC to be available in the Synkop system. From the strategy, areas and standards for measurement are decided and implemented for data collection in the CPR. For the process reviews, the collected data is available for focussed analyses. In a similar manner as the strategy documents, local hypermedia protocols for decision support are formulated by the clinical monitoring workshop as additions to Gösta's Book. The Synkop hypermedia authoring environment enables authors to edit cross references to information in both local reference books and externally produced materials, and to create graphical representations of document collections. Individual practitioners are able to write personal annotations to documents and also feed these back to the authors as comments.

Design experiences: When technologies at the industrial forefront where introduced in the project, the information systems department was not prepared to supply maintenance and service. This was managed by aquiring sanction for broadening of the available policies from the upper management in the health care organization.

DISCUSSION

In line with results from previous studies[16], the main experience from the design of the PRIMUS 2000 system is that for CSCW designs to succeed in health care, not only one design level can be considered. More specifically, the organizational infrastructure has to be identified and the system positioned within it. In the PRIMUS 2000 development process, participatory design has been used to link the design decisions from the teamwork to the health care planning levels, focusing on the level of the clinical unit. Hence, the *structure* of organizational change has been highlighted by that redesign issues simultaneously are dealt with at micro, meso, and macro levels[17].This linking of design levels makes it possible to take advantage of the CSCW system in the development of organizational learning, rather than for isolated decision support or data collection.

Studies in industry have showed that maintenance of positive workplace relations is beneficial also in competitive market environments[18]. A reason for that previous systems designs in health care have come to reside at one organizational level may be that user groups have been homogeously composed, mainly by physicians[19]. However, a recent exception is the *CareGiver Workstation* project, which is structured from the management level down to multi-disciplinary practitioner groups[20]. PRIMUS 2000 is based on a similar structure, but with the addition of *democratic dialogue* rules for meetings and conferences[21]. The first evaluation of the design meetings showed that the influence from practitioners increased with time, which can be seen as a tendency for that these rules have had effect.

In the development of PRIMUS 2000, tensions did occur between the information systems department and the project management. While the former held experience in the maintenance of information systems, the latter had their background mainly in systems design. A possible way to avoid this conflict would have been the availablity of a Chief Information Officer to balance decisions between new technologies and safe routines from a perspective close to organizational strategies[22]. Also, a person in this position could have mediated in formation of alliances between the maintenance staff and the medical informaticians.

This study has situated CSCW in health care within quality management and working-life development. The preliminary data on costs suggest that also small early investments in user-centered design can yield lasting integration effects. Further evaluations can cover the software system, the redesigned service process and the service outcome. The emphasis on long-term effects for health care in PRIMUS 2000 provides a strong reason for integration of these aspects. Therefore, the Quality Function Development method[23] for product evaluation is being customized to function as a repository for interconnected evaluations of CSCW systems in health care.

Acknowledgements
This research was funded by the Swedish National Board for Technical and Industrial Development (NUTEK) and the Swedish Work Environment Fund (AMFO) through the SAMT program. DialogJournalen (TM) is a product from Dialog AB, Sweden.

REFERENCES

1. Gardner RM, Christiansen PD, Tate KE, Laub MB, Holmes SR. Continuous quality improvement methods used to optimize blood transfusion. In: Safran C (ed.). Proceedings of SCAMC '93. New York: McGraw-Hill, 1993.

2. Kim KK, Michelman JE. An examination of factors for the strategic use of information systems in the healthcare industry. MIS Quarterly 1990;june:201-15.

3. Abbott KR, Sarin SK. Experiences with workflow management: issues for the next generation. In: Proceedings of CSCW '94. New York: ACM Press, 1994, pp. 113-20.

4. Carmel E, Whitaker R, George JF. Participatory design versus joint application design: trans-atlantic differences in systems development. In: Muller M, Kuhn S, Meskill JA (eds). Proceedings of PDC '92. Palo Alto: CPSR, 1992.

5. Wood J, Silver D. Joint application design. New Yrok: John Wiley, 1989.

6. Ives B, Olson M. User involvement and and MIS success: a review of research. Management Review 1984;30:586-603.

7. Foote-Whyte W, Greenwood DJ, Lazes P. Participatory action research: through practice to science in social research. In: Participatory action research. Whyte WE (ed). Newbury Park: Sage Publications, 1991, 19-55 .

8. Timpka T, Nyce JM, Sjöberg C, Johansson M. Action Design: From Modeling to Support of the Software Process. Blum BI, Chang CL (eds.). Proceedings of Software Engineering and Knowledge Engineering '93. San Fransisco: IEEE Press, 1993.

9. Timpka T, Sjöberg C, Svensson B. The MEDEA experience: five years of participatory clinical hypermedia design. Computer Programs and Methods in Biomedicine 1995;in press.

10. Timpka T, Hedblom P, Tibblin G. A hypermedia document collection for primary health care: Why, What, and How. Artificial Intelligence in Medicine 1990;2:179-92.

11. Heskett JL. Lessons in the service sector. Harvard Business Review 1987;March-April:118-26

12. Hegner F. The design of chains of actions: a prerequisite for the development and design of service strategies and manegerial processes. In: Brown SW, Gummesson E, Edvardsson B, Gustavsson B. Service Quality. New York: Lexington Books, 1991, 109-2.

13. Juran JM. Quality by design. New York: The Free Press, 1992.

14. Deming WE. The new economics: for industry, goverment, education. Cambridge, Mass.: M.I.T. Centre for Advanced Engineering Study, 1993.

15. Hynes DM. Evaluating productivity in clinical research programs: The National Cancer Instititute's (NCI's) community clinical oncology program. J Med Sys 1992;16:247-67.

16. Star SL, Ruhleder K. Steps towards an ecology of infrastructure: complex problems in design and access for large-scale collaborative systems. In: Proceedings of CSCW '94. New York: ACM Press, 1994, pp . 253-264.

17. van Eijnatten FM, Hoevenaars AM, Rutte CG. Holistic and participative (re)design. In: Hosking D, Anderson N (eds.). Organizing changes nd innovations. London: Routledge, 1992.

18. Ram M. Control and autonomy in small firms: the case of the west midlands clothing industry. Work, Employment and Society 1991;5:601-19.

19. East TD, Morris AH, Clemmer T, et al . Development of computerized critical care protocols: a strategy that really works. In: Miller R (ed). Proc. of SCAMC '90. Washington D.C.: IEEE Press, 1990.

20. Sales S, Mathews P, Gamblin D, Gee S. Caregiver involvement in a large clinical systems project. In: Ozbolt JG (ed). Proceedings of SCAMC '95. Philadelphia: Hanley and Belfus, 1994.

21. Gustavsen B, Engelstad PH. The design of conferences and the evolving role of democratic dialogue in changing working life. Human Relations 1986;39:101-16.

22. Spackman KA, Elert JD, Beck JR. The CIO and medical informatics: alliance for progress. In: Safran C (ed.). Proceedings of SCAMC '93. New York: McGraw-Hill, 1993.

23. Mizuno S, Yoij A (eds.). Quality Function Deployment: the customer-driven approach to quality planning and deployment. Tokyo: Asian Productivity Organization, 1994.